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RESISTANCE TESTS ON THE 5-IN. A. S. PROJECTILE AND THE 6-IN. PROJECTOR CHARGE

by

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ABSTRACT

Resistance tests were conducted in the High Speed Water Tunnel on 2-in. diameter models of the 5-in. A. S. Projectile, Ex 30, and the 6-in. Projector Charge, Ex 1. The 5-in. A. S. Projectile was found to have a terminal sinking velocity of 39.4 fps with armed nose fuse and 35.7 fps for the flat nose projectile without fuse. The terminal sinking velocity for the 6-in. Projector Charge was 34.3 fps with armed nose fuse and 32.6 without the fuse.

MODELS

The 2-in. diameter model of the 5-in. A. S. Projectile Ex 30 (Fig. 1) was constructed to specifications of BuOrd Sketch No.239585 with the exception of the fins which were set at zero degrees instead of the 7° shown in the sketch.

The 2-in. diameter model of the 6-in. Projector Charge Ex 1 (Fig. 1) was constructed to specifications of BuOrd Sketch No. 239308. The 10° fin angle was changed to zero degrees.

Tests were made with the flat nose models and with the armed Ex 102 nose fuse with vanes jettisoned.

DISCUSSION OF RESULTS

Resistance tests of the 6-in. Projector Charge and the 5-in. A. S. Projectile were made in the High Speed Water Tunnel and have been reported previously in Memorandum Report EM-12. 2[(1)]. The results showed variations in drag caused by the tunnel balance. Because of the interaction of pitching moment and drag, which arises from the balance geometry, variations in the results with model support location were observed. These variations amounted to as much as 18 per cent of the total drag. It should be pointed out that such a large drag-pitching moment interaction is not usually observed. The extreme slenderness ratio of the models tested produced large moments which in turn caused relatively high drag errors.

A pitching moment balance was constructed so that the drag results could be separated from the force due to pitching moment. A series of runs was made on the 5-in. A. S. Projectile supported at several different points along the body. The pitching moment varied with the support point, as suspected. However, the drag curves were identical when corrected for the pitching moment interaction.(2)

The results of the runs, using the three-component balance, together with the pitching moment balance, are shown in Fig. 2. The maximum Reynolds number of 10.5×10^6 based on model length is close enough to the Reynolds numbers of the prototypes to allow a short extrapolation of the drag curves.

From the curves shown in Fig. 2 and assuming a weight in seawater of 51.9 lbs,(3) the calculated terminal sinking rates of the 5-in. A. S. Projectile are 35.7 fps for the flat nose case and 39.4 fps with the armed nose fuse. Tests of this shape, conducted at the Alden Hydraulic Laboratory,(3) indicated an average drag coefficient of 0.30 for the flat nose model operating without a cavity. The Alden Laboratory data gives a calculated sinking rate of 36.0 fps, which agrees fairly well with the tunnel data.

Using the estimated weight in sea water of 40.4 lbs (BuOrd sketch No. 239308) for the 6-in. Projector Charge, one finds terminal sinking velocities of 32.6 fps for the flat nose projectile and 34.3 fps with the armed Ex 102 nose fuse. Average drag coefficients of 0.280 with flat nose and 0.185 with armed nose fuse are reported by the Alden Hydraulic Laboratory.(4) Sinking rates calculated from this data were 27.2 and 33.4 fps, respectively.

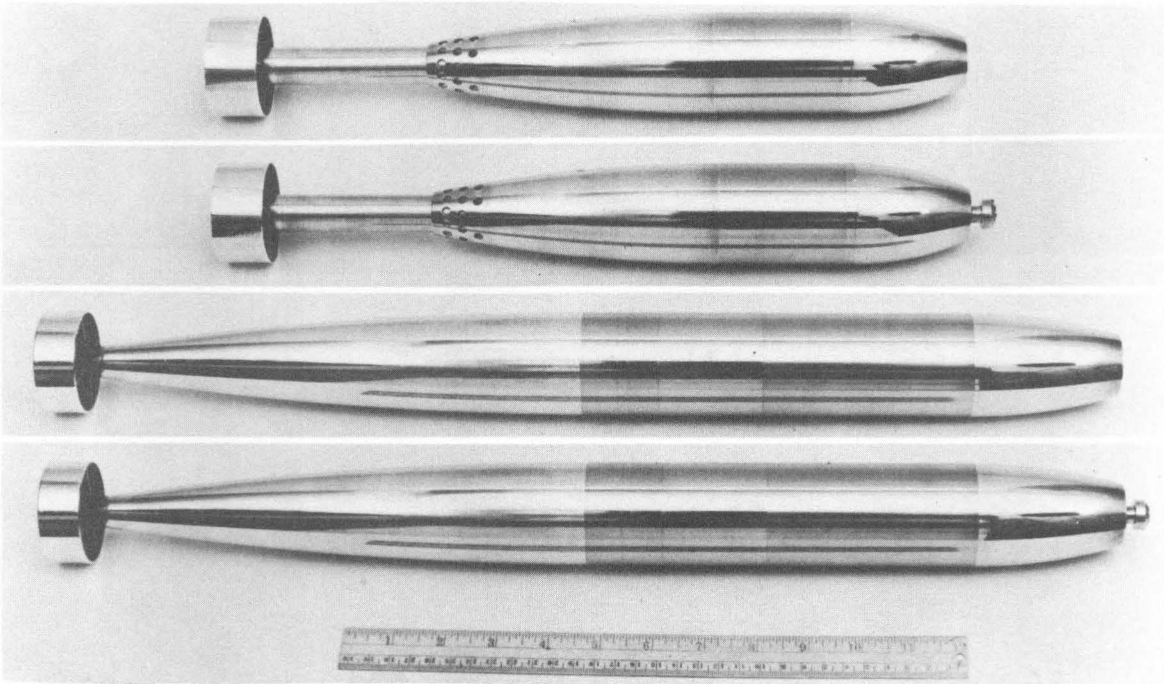

Fig. 1 - Two-inch diameter models of the 6-in. Projector Charge, Ex 1 (top) and the 5-in. A. S. Projectile, Ex 30 (bottom)

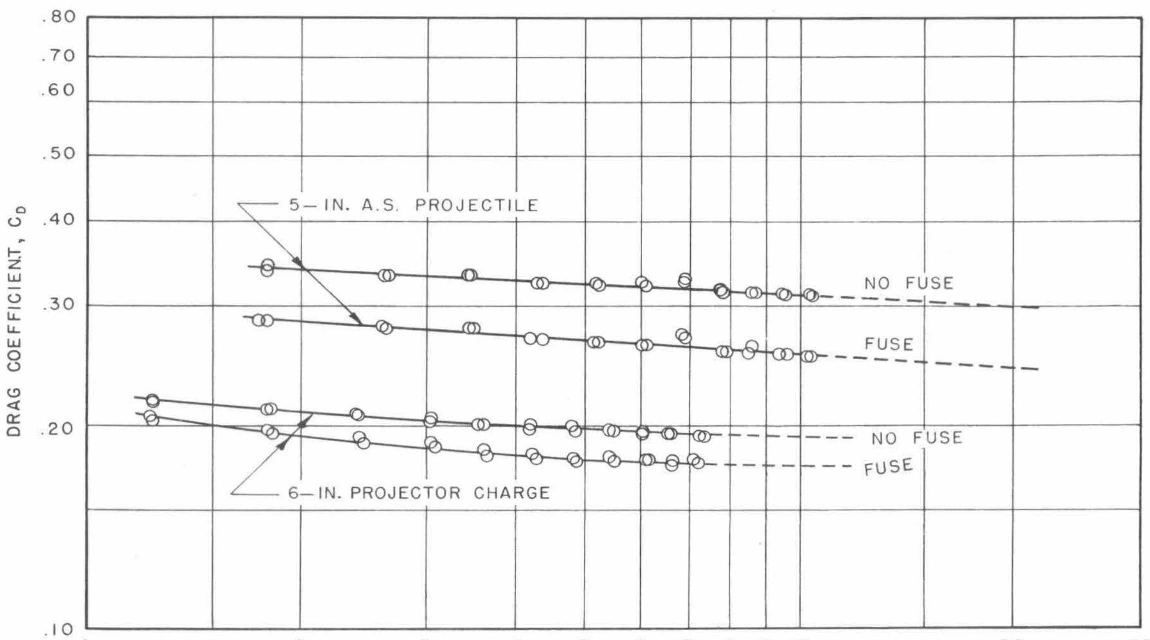

Fig. 2 - Drag coefficient vs. Reynolds number for models of 5-in. A. S. Projectile and 6-in. Projector Charge

APPENDIX

Increased Drag Due to Shroud and Fin Sing

During the drag runs with both the 5-in. A. S. Projectile and the 6-in. Projector Charge, it was noted that at certain velocities a clear singing note could be heard coming from the model tail. Notations were made on the data and it was later observed that in every case where singing was noted, except for the higher frequencies, there was a small but distinct increase in drag. Singing of this type has been observed before in the High Speed Water Tunnel on hydrofoils. As reported by Gongwer,[5] these notes caused by the Karman vortex street would fade as the velocity of the water was increased, disappear, and then reappear as a note of higher frequency. Two points of increased drag corresponding to this fin singing can be seen on the curves for the 5-in.A. S. Projectile (Fig. 2) at Reynolds numbers of 3.5 and 7.0×10^6.

REFERENCES

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2. Kermeen, R. W., "Pitching Moment Balance for the High Speed Water Tunnel", Memorandum Report No. EM 12.4, April 15, 1952.

3. "Underwater Performance of 1-1/4-in. Model of the 5-in. A. S. Projectile, Ex 30," Alden Hydraulic Laboratory Report No. 21, Feb. 1951.

4. "Water Entry and Underwater Performance Characteristics of the 1-1/4-in. Model of the 6-in. Projector Charge, Ex 1," Alden Hydraulic Laboratory Report No. 23, April 1951.

5. Gongwer, C. A., "A Study of Vanes Singing in Water". Aerojet Engineering Corporation, Sept. 1951.

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